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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/043,027	01/09/2002	Jeong-hee Chung	5649-917	6119

20792 7590 11/06/2003

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EXAMINER

VESPERMAN, WILLIAM C

ART UNIT PAPER NUMBER

2813

DATE MAILED: 11/06/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/043,027

Applicant(s)

CHUNG ET AL.

Examiner

William C. Vesperman

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-- **Th MAILING DATE of this communication appears on the cover sheet with the correspondence address --**
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 03 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09/08/2003.
- 2a) ☒ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-6 and 8-23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5 and 8-23 is/are rejected.
- 7) ☒ Claim(s) 6 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 09 January 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4,5. 6) ☐ Other: _____

DETAILED ACTION

1. This action is in response to applicant's amendment of September 8, 2003.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 21 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Derderian et al. (US 2002/0025628 A1) in view of Gates et al. (US 6,203,613 B1).

In regards to 1, 2, 3, 4 and 5, Derderian et al. teaches (Figures 1 - 6, paragraphs 0018 - 0034) a method of forming an integrated circuit capacitor comprising: forming a lower electrode on a substrate (2); forming a metal preprocessed layer on the lower electrode using chemical vapor deposition in which a metal precursor (trimethyl aluminum, TMA) comprises: placing the substrate into a reaction chamber; absorbing the metal precursor in the lower electrode; reacting the metal precursor with the lower electrode (8) made of polysilicon or Ru (RuO) and purging the metal precursor from the reaction chamber; and forming a dielectric layer (12) on the metal pre-processed layer; and forming an upper electrode (14) on the dielectric layer.

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Derderian et al. teaches (paragraph, line 7) that "the invention may encompass other deposition methods not traditionally referred to as ALD, for example, chemical vapor deposition (CVD)". In addition, the applicant in the Detailed Description of Preferred Embodiments, page 4, states that "atomic layer deposition is a type of CVD that includes chemisorbing a flowed source gas on the surface of a substrate and purging the remnant source gas".

Derderian et al. does not teach that the metal precursor comprises oxygen.

Gates et al. teaches (column 2, lines 1 – 20 and column 10, lines 25 - 52) the use of metal precursors comprising oxygen such as metal nitrates: $\text{Ta}(\text{NO}_3)_5$ and $\text{Ti}(\text{NO}_3)_4$ for use in chemical vapor deposition (CVD) processing.

It would be obvious to one skilled in the art, at the time of the invention, to combine the teachings of Derderian et al. and Gates et al. in order to modify the process as taught by Derderian et al. and incorporate the use of metal precursors comprising oxygen (metal nitrates) for use in chemical vapor deposition (CVD) processing as taught by Gates et al.

One would be motivated to incorporate the use of metal precursors comprising oxygen (metal nitrates) for use in chemical vapor deposition (CVD) processing in order to form metal nitrides such as TaN or TiN from $\text{Ta}(\text{NO}_3)_5$ and $\text{Ti}(\text{NO}_3)_4$ respectfully as taught by Gates et al.

In regards to Claims 9, 10, and 11, Derderian et al. teaches (paragraphs 0022, 0028 - 0034) a temperature in the reaction chamber of about 100 to about 600 degrees

centigrade and a pressure of from about .1 Torr to about 10 Torr using nitrogen as a carrier gas for purging the metal precursor.

In regards to Claim 12, Derderian et al. teaches (paragraph 0025) that the dielectric material may include but is not limited to Ta₂O₅ or TiO₂ or ZrO₂.

In regards to Claim 8, Derderian et al. and Gates et al. disclose the claimed invention except do not teach a flow rate of the metal precursor during deposition to be about 1 - 2000 sccm. It would have been obvious to one of ordinary skill in the art at the time of the invention was made to specify a flow rate based on desired pressures of the metal precursor in the reactor during deposition, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. In re Aller, 105, USPQ 233. (CCPA 1955)

In regards to Claims 21 and 22, Derderian et al. teaches (paragraph 0025) at least one of the electrodes might comprise a noble metal (Ru) in the form of RuO.

4. Claims 21, 22 and 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Derderian et al. (US 2002/0025628 A1) and Gates et al. (US 6,203,613 B1) in view of Jou et al. (US 2002/0100959).

Derderian et al. and Gates et al. all the limitations of the claims except do not teach that the metal nitride of the upper electrode is selected from a group of metal nitrides consisting of titanium nitride, tantalum nitride and tungsten nitride.

Jou et al. teaches (paragraph 0031, Figure 2D) that the upper electrode (45) of the capacitor can be formed of a doped polysilicon layer and a metal layer such as TiN, TaN, Ru, Ir, RuO₂ or Pt using CVD.

It would be obvious to one skilled in the art, at the time of the invention, to combine the teachings of Derderian et al. and Gates et al. with Jou et al. in order to modify the process as taught by Derderian et al. and Gates et al and form the upper electrode of the capacitor using construction consisting of a doped polysilicon layer and a metal layer such as TiN, TaN, Ru, Ir, RuO₂ or Pt. as taught by Jou et al.

One would be motivated to incorporate the use of doped polysilicon layer and a metal layer such as TiN, TaN, Ru, Ir, RuO₂ or Pt. construction in order to achieve an efficient upper electrode for the capacitor using CVD processing.

5. Claims 13, 14, 16, 17, 18, 19, 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Derderian et al. (US 2002/0025628 A1) in view of Gates et al. (US 6,203,613 B1).

In regards to 13,14 and 16, Derderian et al. teaches (Figures 1 - 6, paragraphs 0018 – 0034) a method of forming an integrated circuit capacitor comprising: forming a lower electrode on a substrate; forming a metal preprocessed layer on the lower electrode using chemical vapor deposition in which a metal precursor comprises: placing the substrate into a reaction chamber; absorbing the metal precursor in the lower electrode; reacting the metal precursor with the lower electrode and purging the metal precursor from the reaction chamber.

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Derderian et al. does not teach that the metal precursor comprises oxygen.

Gates et al. teaches (column 2, lines 1 – 20 and column 10, lines 1 - 52) the use of metal precursors comprising oxygen such as metal nitrates: $\text{Ta}(\text{NO}_3)_5$ for use in chemical vapor deposition (CVD) processing. In addition, Gates et al. teaches by using the CVD processing sequence: (1) metal nitrate precursor - $\text{Ta}(\text{NO}_3)_5$, (2) inert purge, (3) source gas (H_2O) followed by another inert purge (4), the oxygen in the source gas reacts with the absorbed metal source gas to form the metal oxide (TaO_2).

It would be obvious to one skilled in the art, at the time of the invention, to combine the teachings of Derderian et al. and Gates et al. in order to modify the process as taught by Derderian et al. and incorporate the use of metal precursors comprising oxygen (metal nitrates) for use in chemical vapor deposition (CVD) processing as taught by Gates et al.

One would be motivated to incorporate the use of metal precursors comprising oxygen (metal nitrates) for use in chemical vapor deposition (CVD) processing in order to form metal nitrides or metal oxides such as TaN or TaO_2 using the precursor $\text{Ta}(\text{NO}_3)_5$ as taught by Gates et al.

In regards to Claims 18, 19, and 20, Derderian et al. teaches (paragraphs 0022, 0028 - 0034) a temperature in the reaction chamber of about 100 to about 600 degrees centigrade and a pressure of from about .1 Torr to about 10 Torr using nitrogen as a carrier gas for purging the metal precursor.

In regards to Claim 17, Derderian et al. and Gates et al. disclose the claimed invention except do not teach a flow rate of the metal precursor during deposition to be

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about 1 - 2000 sccm. It would have been obvious to one of ordinary skill in the art at the time of the invention was made to specify a flow rate based on desired pressures of the metal precursor in the reactor during deposition, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. In re Aller, 105, USPQ 233. (CCPA 1955).

In regards to Claims 21 and 22, Derderian et al. teaches (paragraph 0025) at least one of the electrodes might comprise a noble metal (Ru) in the form of RuO.

6. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Derderian et al. (US 2002/0025628 A1) and Gates et al. (US 6,203,613 B1) in view of the Handbook of Chemical Vapor Deposition (CVD), Noyes Publications, Copyright 1992, by Hugh O. Pierson, Page 234, Section 5.6.

Derderian et al. and Gates et al. all the limitations of the claims except do not teach the use of a metal source from a group which includes TaCl₅.

Pierson teaches (page 234, section 5.6) the use of a metal source gas from a group which includes TaCl₅, in order to form a tantalum oxide dielectric using CVD processing.

It would be obvious to one skilled in the art, at the time of the invention, to combine the teachings of Derderian et al. and Gates et al. with Nam et al. in order to modify the process as taught by Derderian et al. and Gates et al. and use a metal source gas consisting of TaCl₅ as taught by Pierson.

One would be motivated to utilize a metal source gas consisting of TaCl₅ as a precursor with a CVD process, to create a layer of Ta to be subsequently reacted with a carrier gas containing oxygen in order to form a tantalum oxide dielectric as taught by Pierson.

Allowable Subject Matter

7. Claim 6 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter. The prior art does not teach or suggest: that the metal precursor comprises a material selected from a group of materials consisting of Ta(OCH₂H₅)₅ and Ta(OCH₃)₅.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Kang (US 6,372,598 B2) teaches a method of forming a selective metal layer on a capacitor.

Lee et al. (US 6,218,260 B1) teaches methods of forming integrated circuit capacitors.

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Lee et al. (US2001/0001501 A1) teaches integrated circuit capacitors having doped electrodes.

Joo et al. (US 6,376,299 B1) teaches a capacitor for a semiconductor memory device.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to William C. Vesperman whose telephone number is 703-305-1939. The examiner can normally be reached on Mon. - Fri., 8:00 - 4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

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October 27, 2003.

Carl Whitehead Jr.
CARL WHITEHEAD, JR.
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